Low Carbon Ukraine

Policy advice on low-carbon policies for Ukraine

Supported by:

Federal Ministry for the Environment, Nature Conservation and Nuclear Safety

based on a decision of the German Bundestag

# Renewable Energy in Ukraine

Dr. Georg Zachmann and Anna Temel

Kyiv, December 2019

Implemented by

Berlin Economics

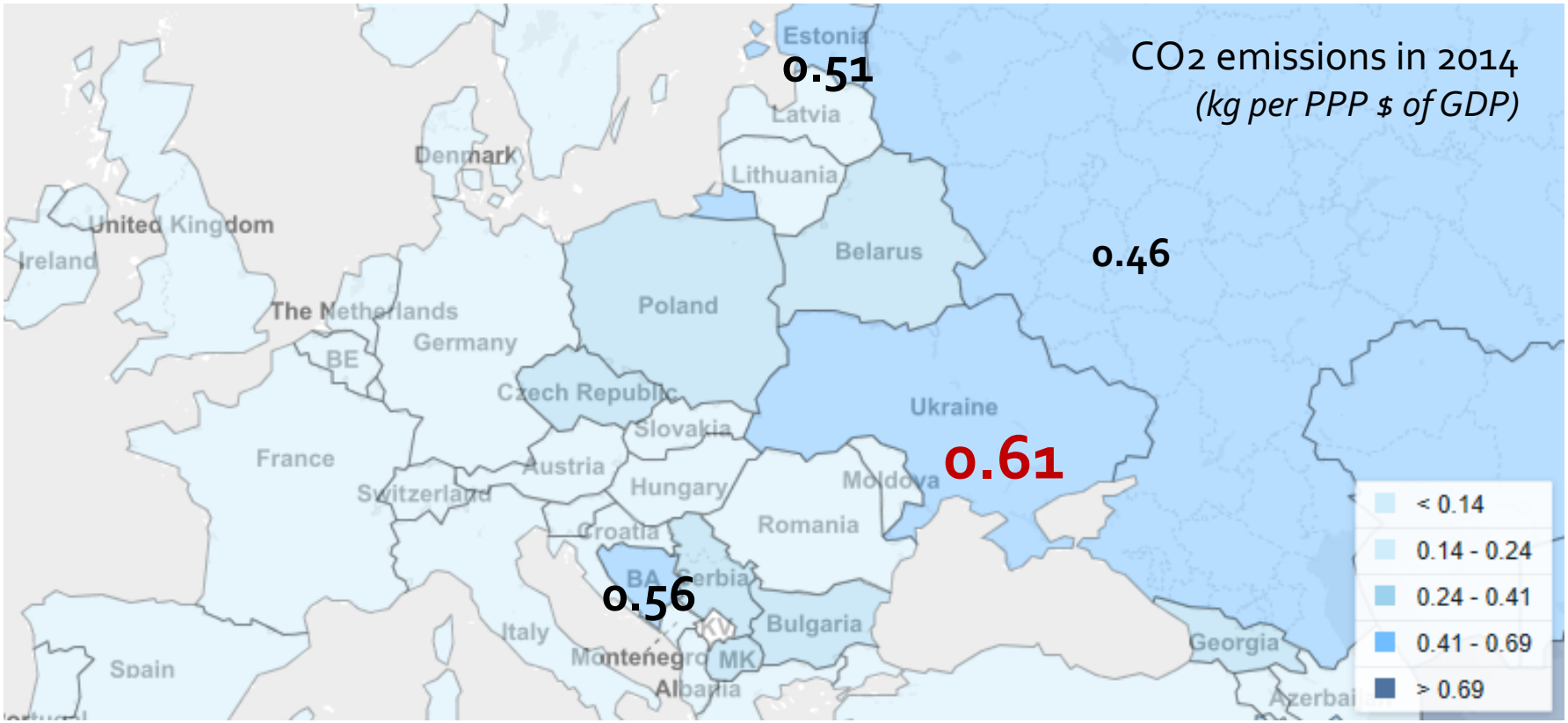
Low Carbon Ukraine

# Agenda

0. Motivation
1. Benefits from RES expansion
2. Status Quo and Potential
3. Challenges
4. Main instruments
5. Outlook

Low Carbon Ukraine

# Ukraine lags behind in comparision with all European countries




Source: Worldbank

Low Carbon Ukraine

# National strategies must reflect higher level of ambition

- Several strategies need to be set or to be revised
  - NDC to UNFCCC
  - Energy Strategy 2035 and Action Plan (runs out in 2020)
  - National Energy Efficiency Action Plan (NEEAP)
  - National Renewable Energy Action Plan (NREAP)
  - National Energy and Climate Plan

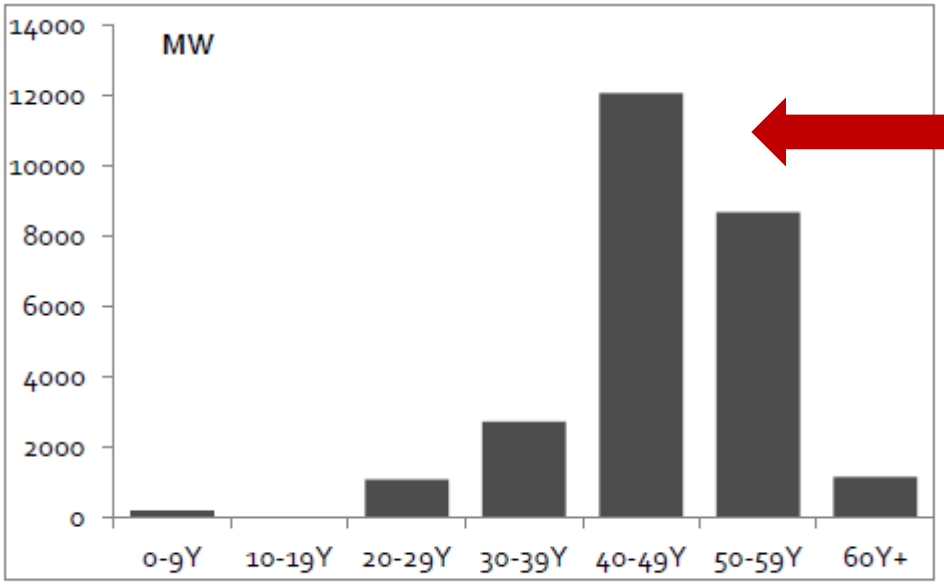
- In 2020, Ukraine has the chance to redefine its overall energy and climate strategy and to **align it with the Paris Agreement**
- **Increasing the share of RES is crucial for increasing climate ambition**

Low Carbon Ukraine

# Benefits

Low Carbon Ukraine

# Ageing power plant fleet needs to be replaced



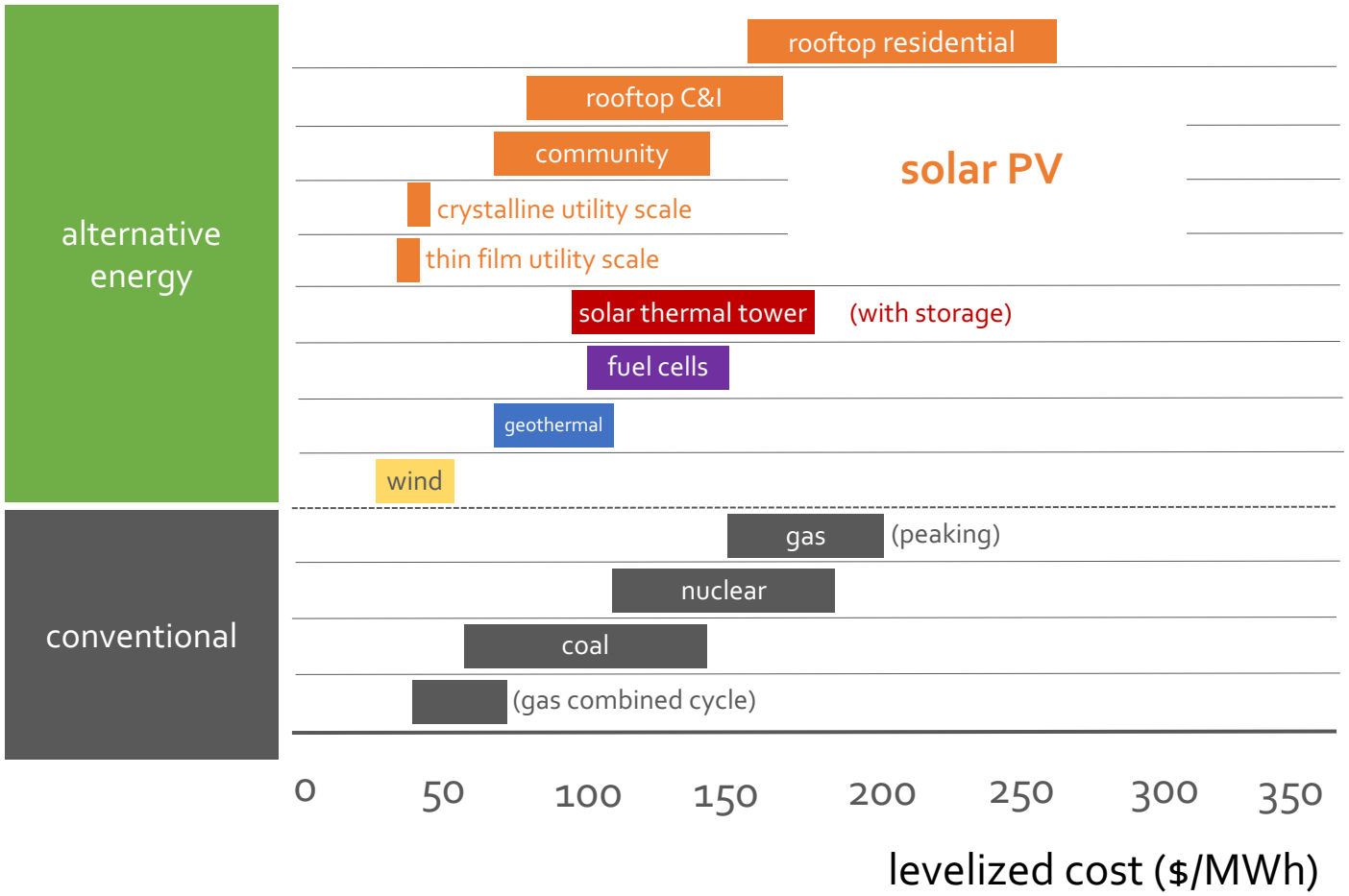

**Most TTP's and CHP's are older than 40 years!**

Source: National Plan for emission reduction; Energy conversion efficiency of 40% is assumed

- In the **medium-term** most power plants in Ukraine need to be overhauled
- **Entailed problems**: Increased costs of maintenance, need for repair, increased risk of unexpected shutdowns, inefficiency

Low Carbon Ukraine

# RES can replace old capacities at **competitive costs**!




Source: Lazard

Low Carbon Ukraine

# RES attracts investment

- A higher RES share triggers investments in **system modernization and efficiency**

- **Attractive conditions:** International financial institutions offer preferential interest rates

Low Carbon Ukraine

# Diversification of energy sources reduces dependencies

- A higher RES share limits dependence on **individual energy sources**
- Ukrainian energy market is highly concentrated
  → RES expansion may **reduce market power** in electricity sector

Low Carbon Ukraine

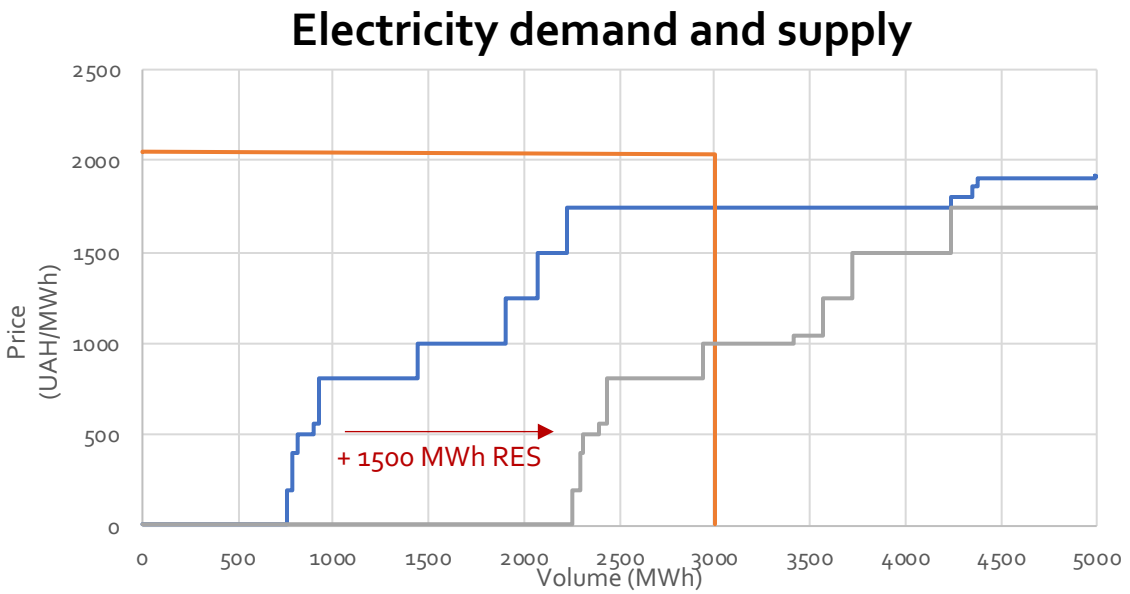
# Diversification of energy sources reduces dependencies

- Reduced **reliance on the import** of electricity and energy resources
  - i.e. 7 GW RES would enable a **reduction of coal imports by 30%** (7 million tons)
  - reduce **political dependencies** arising from imports
  - independence of **fuel price movements**

Low Carbon Ukraine

# More RES in the system reduces electricity price

- Integration of a higher RES share **decreases wholesale price** of electricity, because **marginal costs of RES are zero** (Merit order effect)




Source: own calculations

- Enhanced by **higher level of competition** through energy source diversification

Low Carbon Ukraine

# RES expansion can promote decentralization of energy

- Small facilities managed by communities
- Allows citizens to **participate in energy transition**
- Improves **energy security**, especially in remote areas
- **Relieves grid constraints**

Source: delta-emea

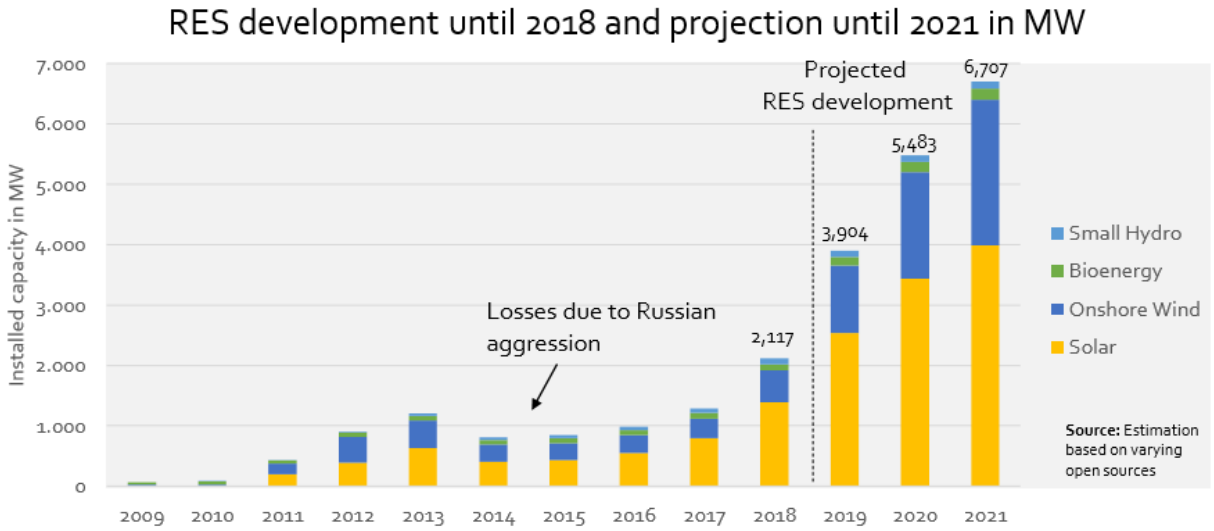
Low Carbon Ukraine

# Status Quo and Potential

Low Carbon Ukraine

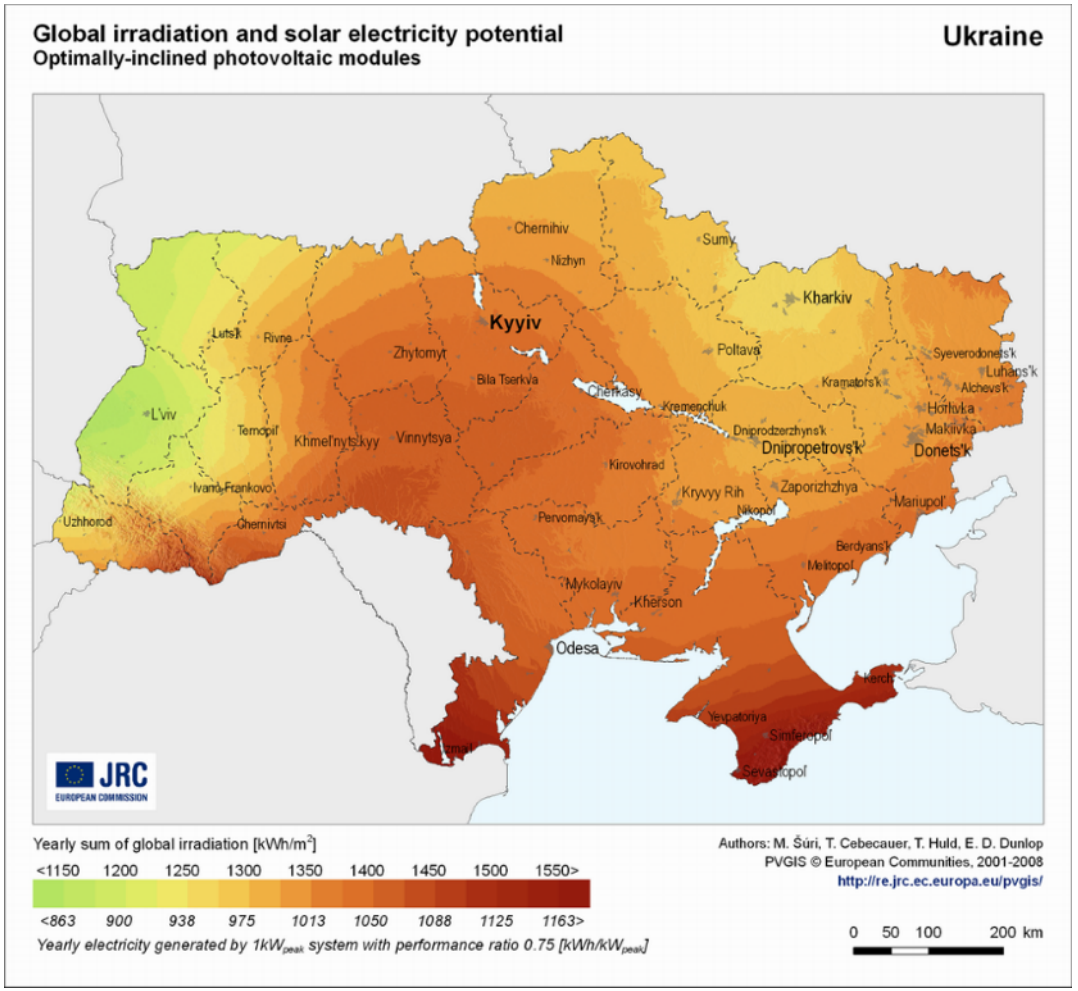
# RES capacities have increased dynamically

- 2018: In 2018 ~750MW of RES were installed
- Around **4.6 GW of new RES projects** are expected for the period 2019 –2021.
- In 2021: likely to cover around **7% of Ukraine`s electricity generation** (excl. Big Hydro)



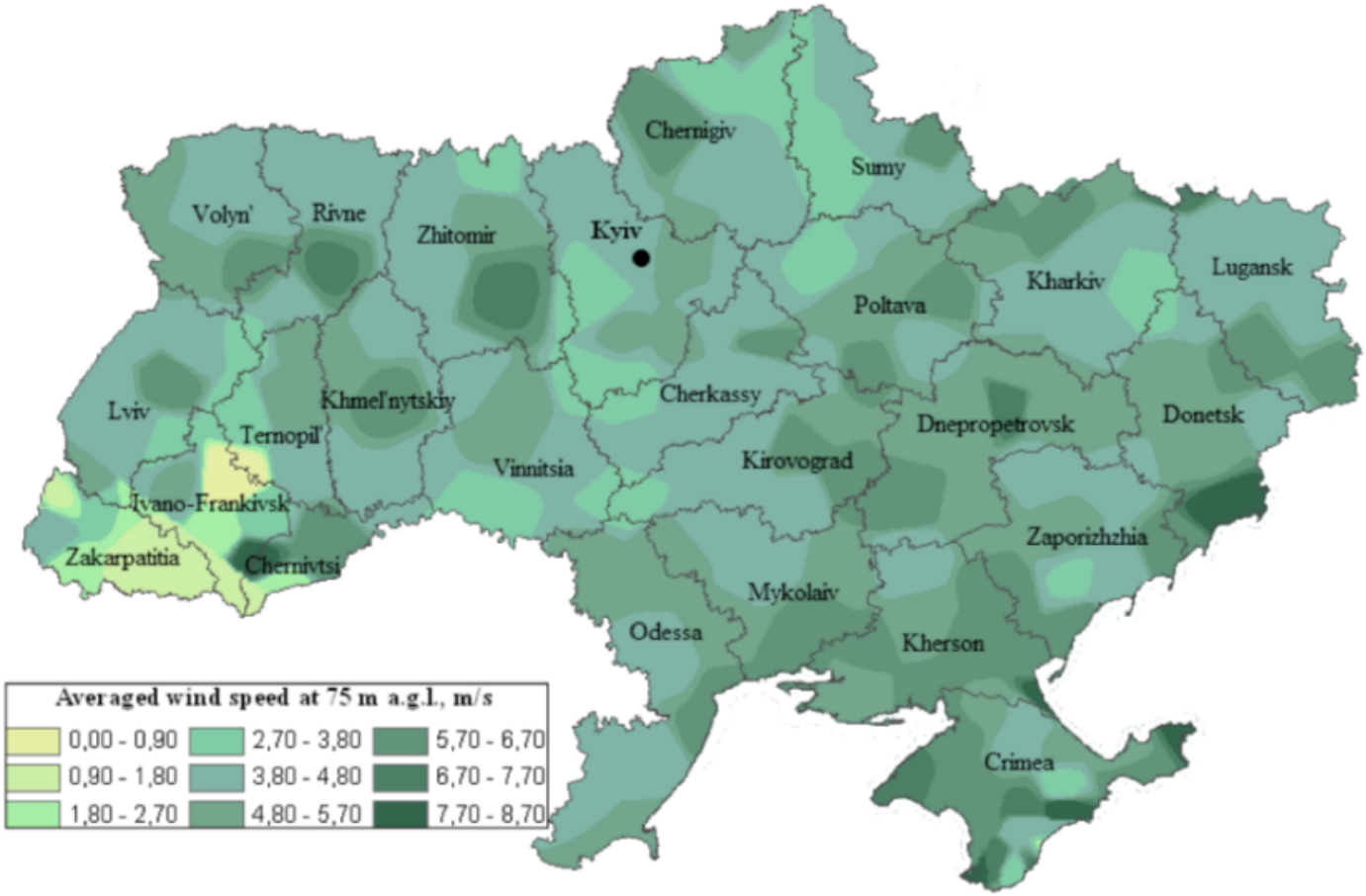
Low Carbon Ukraine

# Huge RES potential: High sun irradiation in large areas



Low Carbon Ukraine

# Huge RES potential: Large areas suitable for wind power

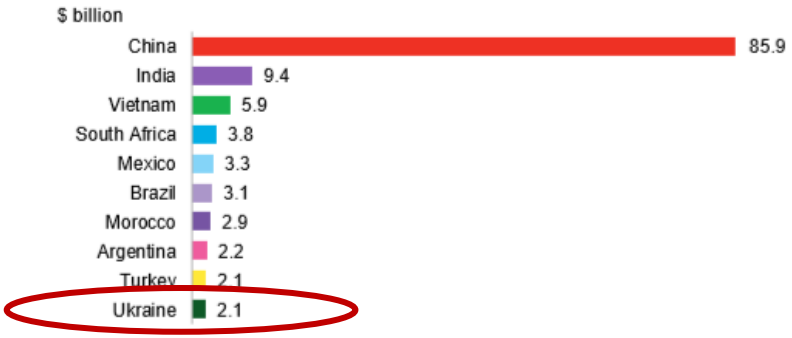


Low Carbon Ukraine

# Investment in RES in Ukraine is attractive

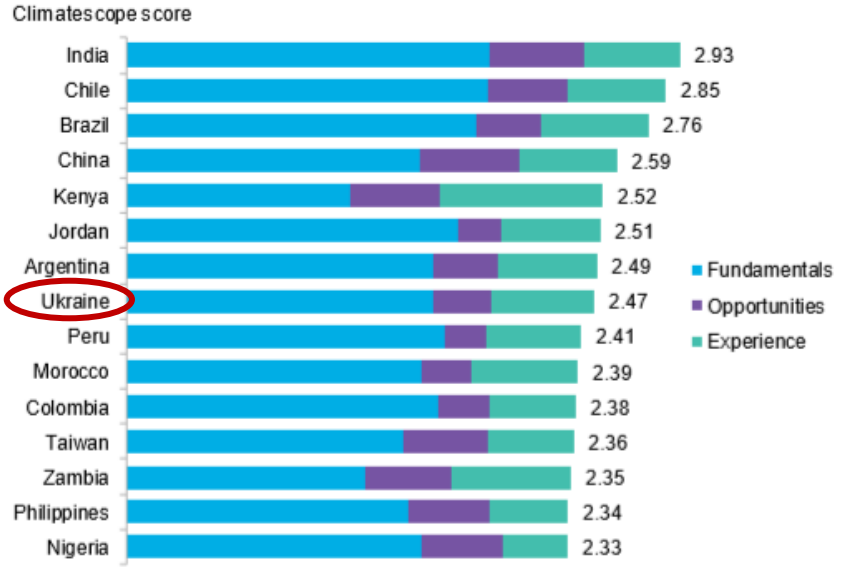
## Investment flows

Ukraine among top 10 developing nations for clean energy asset finance




## Investment attractiveness

Ukraine on 8th rank for investment attractiveness (2018: 63rd rank)

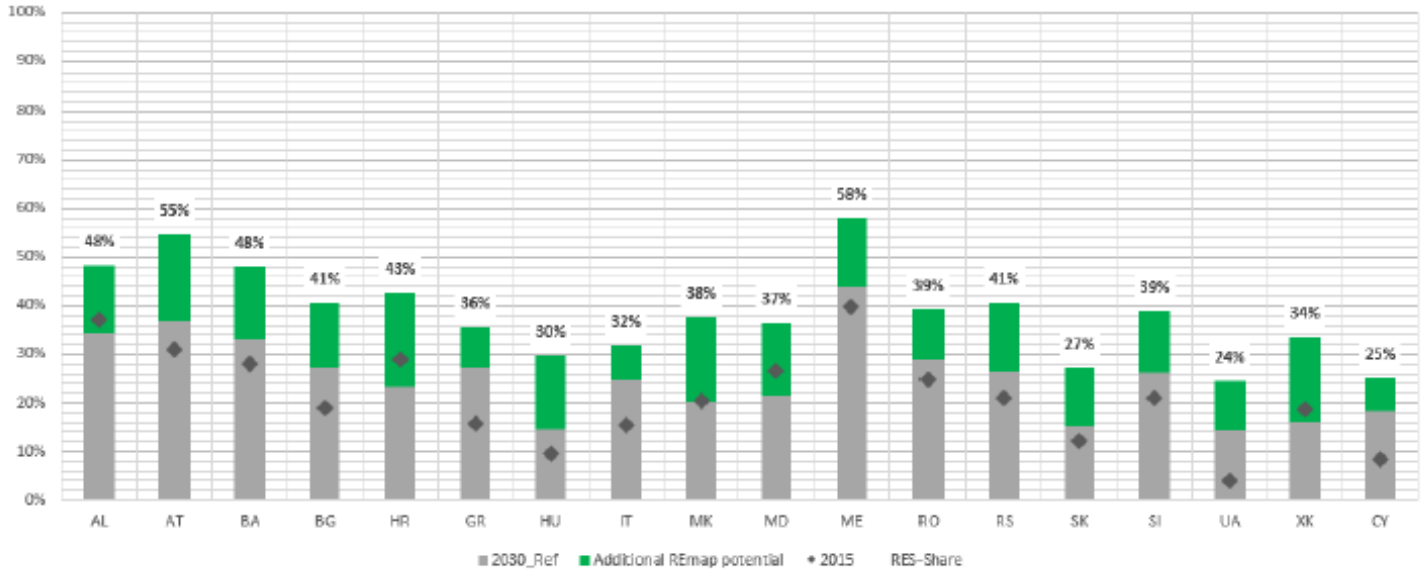



Source: Bloomberg New Energy Finance

Low Carbon Ukraine

# Ukraine risks to stay far below its potential

**Figure 1. Share of renewable energy in gross final energy consumption[8] by CESEC member[9] [%]**




- UA has cost-effective potential to **increase RES share to 24 %** in 2030 compared to expected 17% (IRENA, 2019)

Low Carbon Ukraine

# Challenges

Low Carbon Ukraine

# RES introduces volatility to the system

- Wind and solar power **rely on fluctuating weather conditions**
- Not perfectly predictable

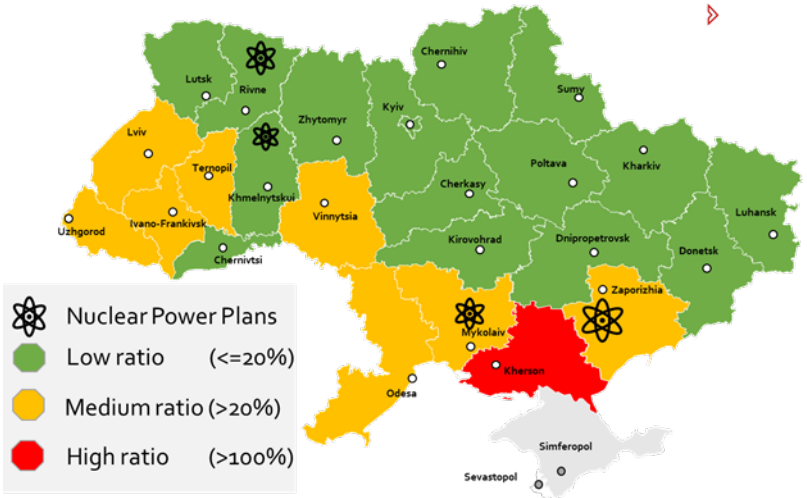
→ Higher RES shares require **more flexible energy infrastructure**

# Local concentration puts electricity network under pressure

- Regional correlation of installations where generation potential is the highest

- Leads to
  - Network restrictions
  - Increased balancing needs
  - Electricity shortage

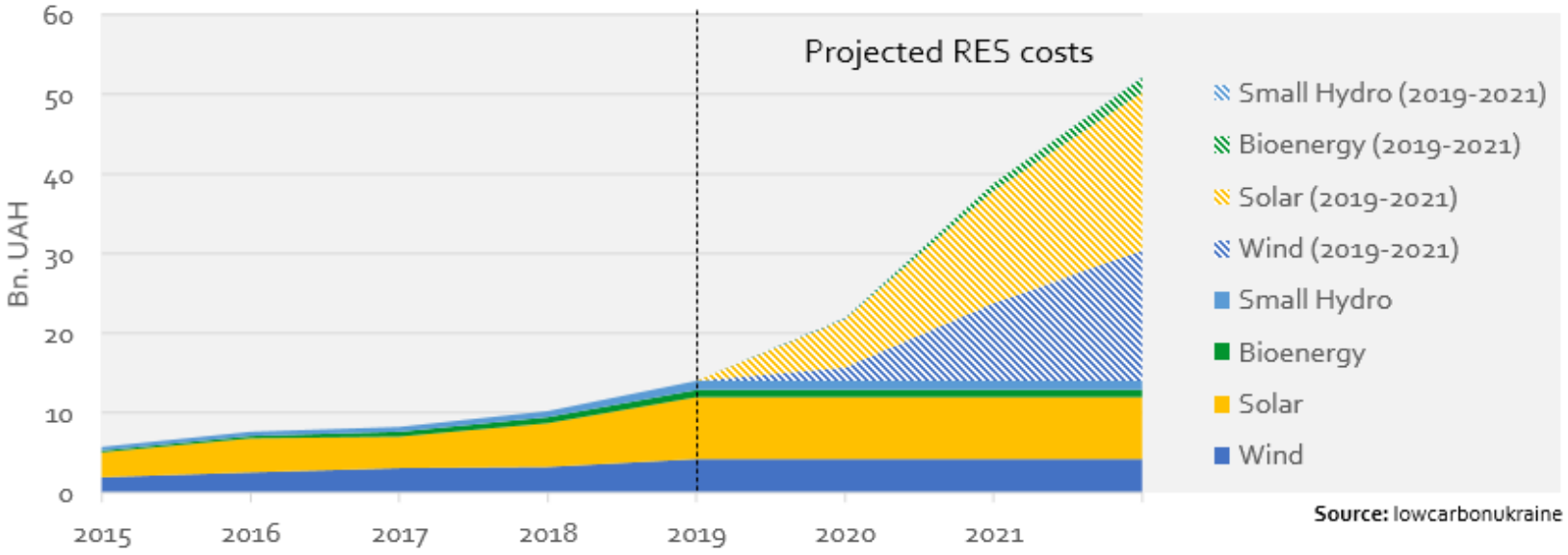
**Max. demand coverage by variable RES in %**




Source: Own calculations

Low Carbon Ukraine

# RES expansion comes at high cost




- Green Tariff clearly **above RES generation cost**
- In 2017, green tariff represented **7-8% of wholesale electricity price**
- Costs are going to continue until 2030

Low Carbon Ukraine

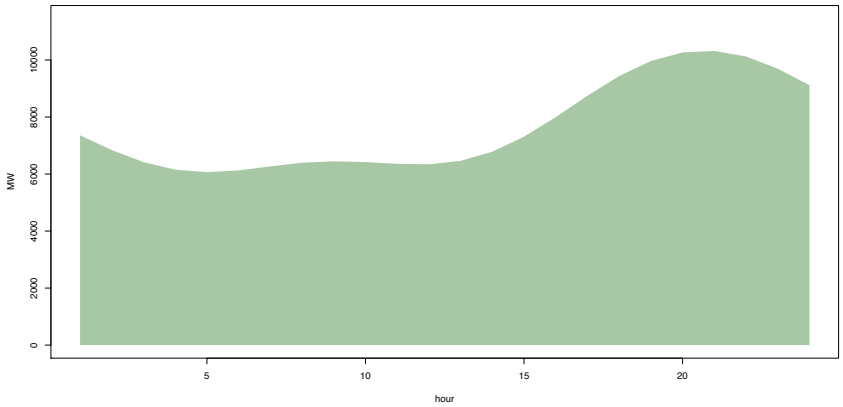
# Instruments

Low Carbon Ukraine

# Wind and solar are able to balance each other

- **Average day profiles of wind and solar differ**
- PV-solar has the peak around noon, average wind profile is quite flat

Average day profile wind




Average day profile solar

# Optimal technology mix

- Wind and solar generation are largely **independent** from one another

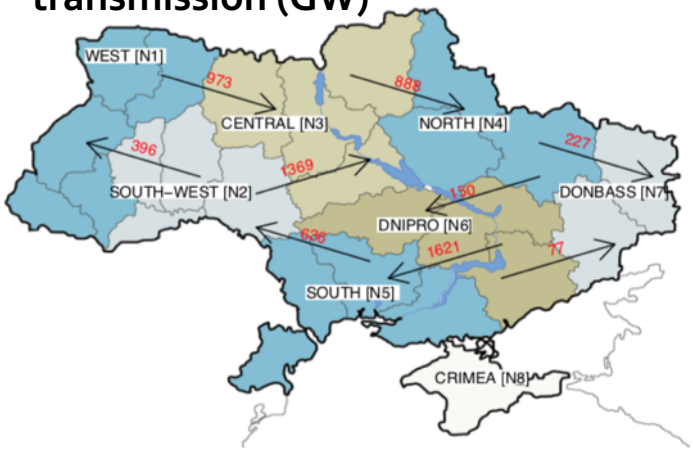
- A **well-chosen mix** of both generation technologies reduces
  - generation cost
  - balancing needs
  - risk of power unavailability

Low Carbon Ukraine

# Optimal location of RES

- Generation levels and fluctuations **differ across locations**
- Wide dispersion of installations allows to **balance the fluctuations** of RES generation (geographic averaging)
- Optimal location selection
  - increases the RES output
  - stabilizes the grid
  - reduces the need for other balancing
  - options

**Modelling of Regional net transmission (GW)**




→**incentives needed** for a wider distribution of installations, i.e. **"regional curtailment charge"**

Low Carbon Ukraine

# Flexible systems can integrate higher shares of RES

- Ensure that **demand is always met by supply**, even if wind does not blow and the sun does not shine
- Options are storage, Open Cycle Gas Turbine, Demand side response and curtailment
- Integration into ENTSOE

## Wind and solar shares in electricity generation for selected countries in 2017

| Country | Total production, TWh | Wind penetration | Solar penetration |
|---|---|---|---|
| **Ukraine** | 155.4 | 0.6% | 0.5% |
| **Germany** | 654 | 18% | 7% |
| **Ireland** | 31 | 26% | - |

Sources: Ukrenergo, Bundesnetzagentur, BMWi, Statistisches Bundesamt, Eirgrid, SONI, seai

Low Carbon Ukraine

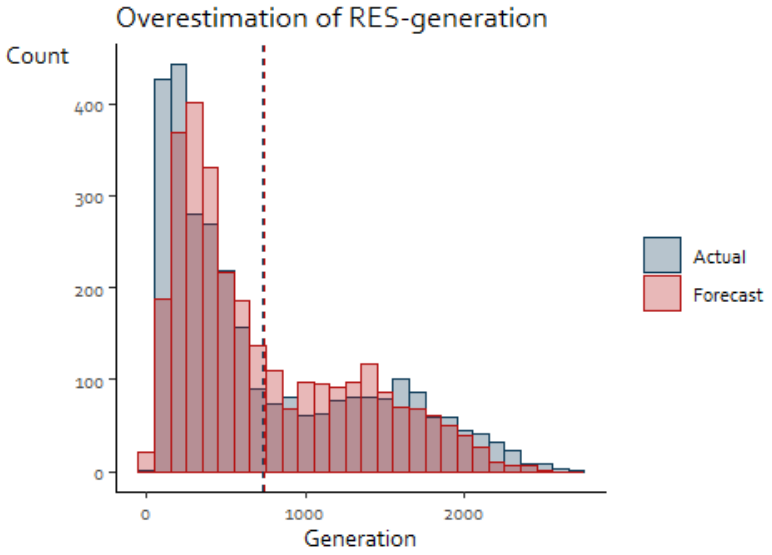
# Curtailment can relieve pressure from the grid

- **Curtailment = Cut of current power generation to avoid overload**
- Relieve situations of **excess power supply**
- mitigate the **green-coal paradox** (keep coal power plants in part-load to balance RES)

Low Carbon Ukraine

# RES forecasts can be improved

- RES generation is **not perfectly predictable**
- But efforts to improve forecasts may **pay off**
- In Germany forecasts could be **substantially improved**
  - average forecast error (50Hz zone) decreased between 2005 and 2018 from 27% to below 2% while RES increased by 200%

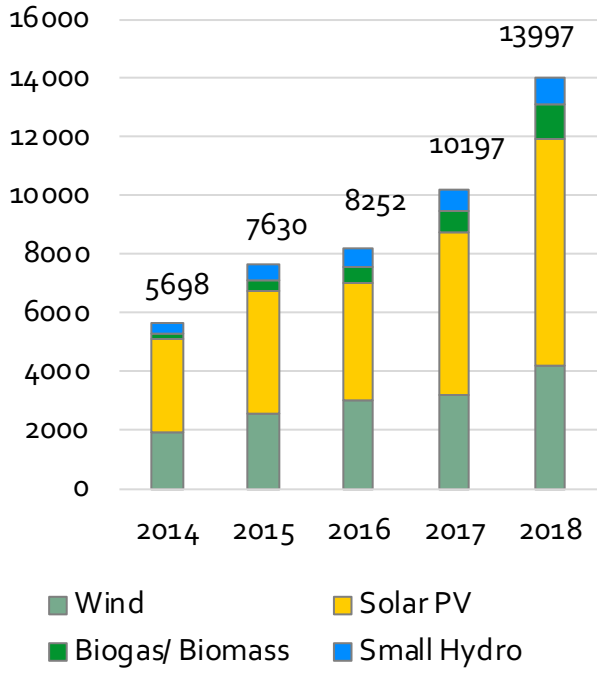



Source: Own calculations

# Well-designed auctions can replace excessive FITs

- Costs for Green Tariff have **risen dramatically** over the last years
- Ukraine will **phase out** the Green Tariff scheme and introduce **RES auctions** from 2020
- If successful, auction scheme can **reduce the costs** of RES support
- Success depends on ensuring sufficient **liquidity**, **competition** and **transparency** at auctions

**Annual costs of Green Tariff in million UAH**




*Source: SE Energorynok, NBU, DiXi Group*

Low Carbon Ukraine

# Outlook

Low Carbon Ukraine

# Translating potential into reality

- Ukraine has large RES potential and the legal fundament (RES law, electricity market law) is in place
- Now lot's of technical and administrative measures needed to ensure a smooth phase-in of renewables
  - Auction rules and amounts
  - Network development
  - Development of flexibility
  - Network operation rules
  - Market operation rules
  - …
- A comprehensive plan to ensure that all elements are put in place would be helpful
- The Prize would be much faster and cheaper RES deployment to the benefit of Ukraine

# Low Carbon Ukraine

Policy advice on low-carbon policies for Ukraine

Supported by:

Federal Ministry
for the Environment, Nature Conservation
and Nuclear Safety

based on a decision of the German Bundestag

**Implemented by:**

Berlin Economics

**Project Leader**
Dr. Georg Zachmann
zachmann@berlin-economics.com

**Project Manager**
Ina Rumiantseva
rumiantseva@berlin-economics.com

www.lowcarbonukraine.com
Tel.: 030 2064 34 64 – 0